

DATA SHEET

MAQUET

VENTILATION  
SERVO-i INFANT

CRITICAL CARE





## SERVO-i INFANT – SENSITIVE VENTILATION OF NEONATAL AND PEDIATRIC PATIENTS

### MAQUET – THE GOLD STANDARD



**Leading the way:** MAQUET is a premier international provider of medical technology solutions. Focused on the OR and ICU, the company is committed to developing solutions that improve patient care.

MAQUET draws on many years' experience in supplying state-of-the-art ventilator systems. Since the introduction of the first SERVO ventilator in 1971, SERVO has become the world's number one ventilation brand.

SERVO-i now sets the standard for critical care ventilation. It delivers the highest level of clinical performance to help

clinicians provide the best possible care for neonatal, pediatric and adult patients.

SERVO-i is also very simple to learn and use. Designed to be easily upgradeable, it grows with the hospital's changing needs to ensure lasting value.

**SERVO-i Infant:** Sensitive ventilation of neonatal and pediatric patients

MAQUET – The Gold Standard.

## HIGHLIGHTS

### SERVO-i INFANT

- For neonatal to pediatric patients
- Standard ventilation modes:
  - Controlled ventilation:
    - Pressure Control (PC)
  - Supported ventilation:
    - Pressure Support (PS)/CPAP
  - Combined ventilation:
    - SIMV (PC) + PS
- Optional ventilation modes:
  - Controlled ventilation:
    - Volume Control (VC)
    - Pressure Regulated Volume Control (PRVC)
  - Supported ventilation:
    - Volume Support (VS)
  - Combined ventilation:
    - SIMV (VC) + PS (included in the VC option)
    - SIMV (PRVC) + PS (included in the PRVC option)
    - Bi-Vent
  - Non invasive modes:
    - Nasal CPAP
    - Non Invasive Ventilation (NIV) Pressure Support
    - Non Invasive Ventilation (NIV) Pressure Control
- Optional functions:
  - Automode® (Pressure/Volume/PRVC)
  - Upgrade to SERVO-i Universal all patient categories (Adult & Infant)
  - Nebulizer
  - Open Lung Tool®
  - Y sensor measuring
  - CO<sub>2</sub> analyzer
  - Alarm output connector for external alarm
- A platform for the future – choose the level of system and application you need for today; add further functionalities for tomorrow
- Y sensor measuring of flow and pressure for measurements closer to the patient's airways
- Supports invasive ventilation as well as non invasive ventilation with leakage compensation
- Simple user interface:
  - Selectable between touch screen, knobs or dial
  - Direct access knobs for vital settings
  - Menues with only two main levels
- Flexible placement – easy positioning, either on a SERVO-i Mobile Cart, or on a SERVO-i Holder or a SERVO-i Shelf Base for bed/shelf/wall mount
- Uninterrupted bedside quality ventilatory treatment during transportation of ICU patients
- Designed for cost-efficiency:
  - Easy training, operation and maintenance
  - Fast, simple start-up procedures with user configured pre-set ventilator settings
  - One-piece interchangeable part for cleaning
  - Extended maintenance intervals
  - Quick access to previous ventilation mode settings
- Non-consumable and maintenance-free ultrasonic O<sub>2</sub> sensor optional to consumable O<sub>2</sub> cell
- Modular – a common base ventilator with your choice of functionalities and convenient interchangeable plug-in units – battery modules, CO<sub>2</sub> module and Y sensor module

## GENERAL INFORMATION

### SERVO-i INFANT

**SERVO-i® Infant** supports neonatal and pediatric patients through multiple ventilation modes and sensitive triggering responses.

With its compact design, advanced functionality and ease of use **SERVO-i Infant** is well suited for virtually all infant ventilation needs in the Intensive Care Unit and for patient transportation within the hospital. **SERVO-i** is also highly suited for interhospital transport of ICU patients with its long battery operating time and optimized gas consumption\*.

Compact and flexible design makes it easy to position the equipment as desired for best access and convenient operation. The patient unit can be turned for patient connection from the left or right side. The user interface can be turned and tilted for convenient handling and overview.

**The 'Lift Out' capabilities** – using the **SERVO-i Mobile Cart**, the **SERVO-i Holder** and/or the **SERVO-i Shelf Base** – increase flexibility and facilitate patient transportation with no loss of treatment values. The **SERVO-i Holder** and the user interface can be placed on a wall, a shelf or on the bed.

\* Interhospital transport use of **SERVO-i** requires a formal agreement with MAQUET.



*The **SERVO-i** patient unit and user interface can easily be removed from the Mobile Cart ...*

*... and positioned on the **SERVO-i** Holder for bedside placement flexibility.*

## GENERAL INFORMATION

### SERVO-i INFANT



*SERVO-i supports both invasive ventilation and Non Invasive Ventilation (NIV).*

**SERVO-i supports** invasive ventilation and also Non Invasive Ventilation (NIV) with an effective leakage compensation, thus maintaining the pressure set to the patient. NIV supports ventilation in the Pressure Control and Pressure Support modes. In the case of apnea, a ventilator controlled breathing frequency is automatically activated to maintain desired ventilation.

**SERVO-i Infant offers** a wide range of ventilation modes and tools with sensitive triggering responses to meet a variety of upcoming ventilation needs. Modes well suited for infant ventilation come as standard with the ventilator. For future needs more modes and functions can easily be added by means of a PC card.

**The Nasal CPAP mode** provides nasal CPAP ventilation for the smallest patients. Combined with nasal prongs or nasal masks it delivers a constant airway pressure to the patient.

**The Pressure Support ventilation mode** reduces the work of breathing and responds instantly to the child's changing needs. Preset ranges for relevant parameters are automatically set, even when changing from one mode to another. Preferred treatment parameters can be safely and flexibly customized.

**With Y Sensor Measuring** it is possible to measure flow and pressure as close as possible to the patient's airway. The sensor connected to the Y-piece presents accurate measurements on the user interface.

**The user can configure the ventilator** to start up exactly the way he wants. The default ventilation mode as well as all the corresponding default ventilation parameters can be set by the user.

**The Automode® option** allows complete, automatic patient interaction for shorter weaning times, less staff intervention and better patient comfort with less sedation.

**A back-up apnea function** ensures safe ventilation in support modes. The sensitive triggering system helps minimize the work of breathing.

**The Suction Support function** pauses the ventilator from cycling during a tracheal suction procedure. The oxygen concentration can be manually set during pre- and post oxygenation phases.

## GENERAL INFORMATION

### SERVO-i INFANT

**The Open Lung Tool® (OLT)** can be used for graphical visualization of measured and calculated values for easier interpretation of patient response to user controlled lung recruitment procedures. The OLT can also be used as a breath by breath trend monitor of collected and stored parameter data.

**The monitoring capabilities of SERVO-i** ensure more accurate time and detail recording through trend alternatives. Information can be retrieved for further analysis up to 24 hours after an event.

**Mainstream CO<sub>2</sub> measurement** and calculations are displayed on the user interface.

**Two nebulizer systems are available.** The Servo Ultra Nebulizer is an integrated system based on ultra sonic technology. As an option the Aeroneb Pro, a stand-alone system based on vibration technology is also available. The small and lightweight Aeroneb Pro nebulizer unit makes it also suitable for the smallest patients.

**Patient data and screen pictures** can easily be saved and exported to a PC by means of a Ventilation Record Card for archiving, later analysis or research.

**SERVO-i is now available** with a non-consumable and maintenance-free O<sub>2</sub> sensor as an option to the consumable O<sub>2</sub> cell, which needs replacement about once a year. The new O<sub>2</sub> sensor is based on ultrasonic technology. Existing SERVO-i ventilators can easily be upgraded.



**The SERVO-i can easily be equipped** with plug-in modules – a CO<sub>2</sub> Analyzer Module, a Y Sensor Module and additional battery modules. The modules can easily be interchanged between different SERVO-i units.

**All waveform and parameter values** for 20 seconds can be saved by pressing a button. The recorded values can be recalled on the screen, and the values can also be transferred to a Ventilation Record Card.

**The SERVO-i offers** a variety of unique accessories, such as the SERVO-i Holder/Shelf Base and the dockable Gas trolley.

## TECHNICAL SPECIFICATIONS

### SERVO-i INFANT

#### The system – General

|                                            |                                                                                     |
|--------------------------------------------|-------------------------------------------------------------------------------------|
| <b>CE</b><br>0413                          | The device complies with requirements of Medical Device Directive 93/42/EEC.        |
| Classification:                            | Class I equipment. According to IEC 60 601-1/EN 60 601-1.                           |
| Standards:                                 | EN IEC 60 601-1 (Class I, Type B).<br>IEC 60 601-2-12.<br>EN 794-1.<br>ASTM F 1100. |
| Electromagnetic compatibility (EMC):       |                                                                                     |
| – Emission:                                | According to EN IEC 60601-1-2 (CISPR 11, interference level B).                     |
| – Immunity:                                | According to EN IEC 60601-1-2.                                                      |
| Patient range:                             |                                                                                     |
| – Invasive ventilation:                    | Weight 0.5 – 30 kg.                                                                 |
| – Non Invasive Ventilation – NIV           | Weight 3 – 30 kg.                                                                   |
| Pressure Control and NIV Pressure Support: |                                                                                     |
| – Non Invasive Ventilation – Nasal CPAP:   | Weight 0.5 – 10 kg.                                                                 |

#### Operating conditions

|                                      |                          |
|--------------------------------------|--------------------------|
| Operating temperature:               | +10 to +40°C             |
| Relative humidity:                   | 15 to 95% non-condensing |
| Atmospheric pressure:                | 660 to 1060 hPa          |
| Lowest pressure in breathing system: | –400 cm H <sub>2</sub> O |

#### Non-operating conditions

|                               |                                                                               |
|-------------------------------|-------------------------------------------------------------------------------|
| Impact:                       | Peak acceleration: 15 g.<br>Pulse duration: 6 ms.<br>Number of impacts: 1000. |
| Storage temperature:          | –25 to +60° C (–13 to 140° F)                                                 |
| Storage Relative Humidity:    | < 95%                                                                         |
| Storage Atmospheric Pressure: | 470 to 1060 hPa                                                               |

#### Power supply

|                                          |                                                                                                   |
|------------------------------------------|---------------------------------------------------------------------------------------------------|
| Power supply, automatic range selection: | 100 – 120 V AC ±10%, 50 – 60 Hz, or 220 – 240 V AC ±10%, 50 – 60 Hz.                              |
| Plug-in battery module:                  |                                                                                                   |
| – Battery backup:                        | Two battery modules are delivered with the ventilator. Up to six battery modules can be included. |
| – Battery capacity:                      | Rechargeable, 12 V, 3.5 Ah each.                                                                  |
| – Recharge time:                         | Approximately 3 h/battery.                                                                        |
| – Battery backup time:                   | Approximately 3 h, when using six batteries.                                                      |
| External 12 V DC:                        | 12.0 V – 15.0 V DC, 10 A                                                                          |
| Max power consumption:                   | At 100 – 120 V: 2 A, 190 VA, 140 W.<br>At 220 – 240 V: 1 A, 190 VA, 140 W.                        |

#### The ventilator – General

|                          |                                                               |
|--------------------------|---------------------------------------------------------------|
| Dimensions:              | (See dimensional drawings page 16–17.)                        |
| – User Interface:        | W 355 x D 53 x H 295 mm                                       |
| – Patient Unit:          | W 300 x D 205 x H 415 mm                                      |
| Weight:                  | Approximately 20 kg (Patient Unit 15 kg, User Interface 5 kg) |
| Method of triggering:    | Flow and pressure                                             |
| Max. operating pressure: | Approximately 115 cm H <sub>2</sub> O                         |
| Bias flow:               | 0.5 l/min                                                     |

#### Gas supply

|                                       |                                                                                                                                                     |
|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Inlet gas pressure:                   | 200 – 650 kPa / 2.0 – 6.5 bar / 29 – 94 PSI                                                                                                         |
| Connection standards available:       | AGA, DISS, NIST, or French standard.                                                                                                                |
| Unavailable gas/loss of gas pressure: | The flow from an unavailable gas (air or O <sub>2</sub> ) is automatically compensated for so that the patient gets the preset volume and pressure. |

#### Patient system gas connectors

|                   |                                                              |
|-------------------|--------------------------------------------------------------|
| Conical fittings: | Male 22 mm / female 15 mm.<br>In accordance with ISO 5356-1. |
| Gas exhaust port: | Male 30 mm cone                                              |

## TECHNICAL SPECIFICATIONS

### SERVO-i INFANT

#### User Interface

|             |                                                                                  |
|-------------|----------------------------------------------------------------------------------|
| Weight:     | approximately 5 kg                                                               |
| Attachment: | Can be attached to the mobile cart, a table, rail or pole (15 – 30 mm diameter). |

#### Screen

|               |                        |
|---------------|------------------------|
| Type:         | TFT-LCD module         |
| Size:         | 31 cm (12.1") diagonal |
| Viewing area: | 246.0 x 184.5 mm       |

#### Inspiratory channel

|                               |                                               |
|-------------------------------|-----------------------------------------------|
| Pressure drop:                | Max. 6 cm H <sub>2</sub> O at a flow of 1 l/s |
| Internal compressible factor: | Max. 0.1 ml/cm H <sub>2</sub> O               |
| Gas delivery system:          | Microprocessor controlled valves              |
| Inspiratory flow range:       | 0 to 0.55 l/s                                 |

#### Expiratory channel

|                                         |                                                         |
|-----------------------------------------|---------------------------------------------------------|
| Pressure drop:                          | Max. 3 cm H <sub>2</sub> O at a flow of 1 l/s           |
| Internal compressible factor:           | Max. 0.1 ml/cm H <sub>2</sub> O                         |
| PEEP regulation:                        | Microprocessor controlled valves                        |
| Rise time, expiratory flow measurement: | <12 ms for 10 – 90 % response at flow of 0.05 – 3.2 l/s |
| Expiratory flow range:                  | 0 to 3.2 l/s                                            |

#### Alarms

|                                            |                             |
|--------------------------------------------|-----------------------------|
| Airway pressure (upper):                   |                             |
| – Invasive ventilation:                    | 16 – 90 cm H <sub>2</sub> O |
| – Non Invasive                             | 16 – 60 cm H <sub>2</sub> O |
| Ventilation:                               |                             |
| Expired minute volume (Upper alarm limit): | 0.01 – 30 l/min             |
| Expired minute volume (Lower alarm limit): | 0.01 – 20 l/min             |

|                                                                      |                                                                                                    |
|----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| Apnea:                                                               | 5 – 45 s                                                                                           |
| Respiratory frequency:                                               | 1 – 160 breaths/min                                                                                |
| High end expiratory pressure:                                        | 0 – 55 cm H <sub>2</sub> O                                                                         |
| Low end expiratory pressure:                                         | 0 – 47 cm H <sub>2</sub> O.<br>Note. Setting the alarm to 0 (zero) is equal to alarm off.          |
| High continuous pressure:                                            | Set PEEP level + 15 cm H <sub>2</sub> O exceeded for more than 15 seconds.                         |
| O <sub>2</sub> concentration:                                        | Set value ±6 vol% or ≤18 vol%                                                                      |
| Gas supply:                                                          | Below 200 kPa / 2.0 bar / 29 PSI and above 650 kPa / 6.5 bar / 94 PSI                              |
| Battery:                                                             | Limited battery capacity: 10 min.<br>No battery capacity: less than 3 min.<br>Low battery voltage. |
| End-tidal CO <sub>2</sub> (upper and lower limit):                   | 0.5 – 20%.<br>4 – 100 mm Hg.<br>0.5 – 14 kPa.                                                      |
| Leakage out of range in NIV:                                         | Yes. Described in the User's manual.                                                               |
| No patient effort in NIV:                                            | 15 s                                                                                               |
| Technical:                                                           | Yes. Described in the User's manual.                                                               |
| Autoset (alarm limits) specification*:                               | * Invasive ventilation, controlled modes only                                                      |
| – High airway pressure:                                              | Mean peak pressure +10 cm H <sub>2</sub> O or at least 35 cm H <sub>2</sub> O.                     |
| – Upper minute volume:                                               | Expiratory minute volume + 50%.                                                                    |
| – Lower minute volume:                                               | Expiratory minute volume – 50%.                                                                    |
| – Upper respiratory frequency:                                       | Breathing frequency + 40%.                                                                         |
| – Lower respiratory frequency:                                       | Breathing frequency – 40%.                                                                         |
| – High end expiratory pressure:                                      | Mean end expiratory pressure + 5 cm H <sub>2</sub> O.                                              |
| – Low end expiratory pressure:                                       | Mean end expiratory pressure – 3 cm H <sub>2</sub> O.                                              |
| – Upper end tidal carbon dioxide concentration (etCO <sub>2</sub> ): | End tidal carbon dioxide concentration + 25%.                                                      |
| – Lower end tidal carbon dioxide concentration (etCO <sub>2</sub> ): | End tidal carbon dioxide concentration – 25%.                                                      |

## TECHNICAL SPECIFICATIONS

### SERVO-i INFANT

#### Ventilation Modes – Invasive ventilation

Controlled ventilation:

- Pressure Control (PC): Pressure controlled ventilation.
- Volume Control (VC) (optional): Volume controlled ventilation.
- PRVC (optional): Pressure regulated volume controlled ventilation.

Supported ventilation:

- Volume Support (VS) (optional): Volume supported ventilation.
- Pressure Support (PS)/CPAP: Pressure supported ventilation / Continuous Positive Airway Pressure ventilation.

Combined ventilation\*: \* Comes with the corresponding controlled ventilation mode.

- SIMV (VC) + PS (optional): Synchronized Intermittent Mandatory Ventilation based on volume controlled ventilation with pressure support.
- SIMV (PC) + PS: Synchronized Intermittent Mandatory Ventilation based on pressure controlled ventilation with pressure support.
- SIMV (PRVC) + PS (optional): Synchronized Intermittent Mandatory Ventilation based on pressure regulated volume controlled ventilation with pressure support.
- Bi-Vent (optional): Pressure controlled ventilation on two independently adjustable levels, allowing unrestricted spontaneous breathing on both levels.

– Automode (optional):

Control mode: VC <—> Support mode: VS  
Control mode: PC <—> Support mode: PS  
Control mode: PRVC <—> Support mode: VS

#### Ventilation modes – Non Invasive Ventilation (optional)

- NIV Pressure Control: Non-invasive pressure controlled ventilation.
- NIV Pressure Support: Non-invasive pressure supported ventilation.
- Nasal CPAP: Nasal Continuous Positive Airway Pressure ventilation.

#### Loop and waveform presentations

- Loops: Volume / Pressure\*\*.  
Flow / Volume\*\*.

\*\*Displayed simultaneously with Open Lung Tool graphical trends, if requested.  
A reference loop and three overlaying loops can be displayed on the screen.

- Real time waveforms: Pressure waveform.  
Flow waveform.  
Volume waveform.  
CO<sub>2</sub> waveform\*.

\* Requires SERVO-i CO<sub>2</sub> Analyzer option connected.

## TECHNICAL SPECIFICATIONS

### SERVO-i INFANT

| Monitoring                                                    | Displayed value | Trended value*<br>* Stored trend values for up to 24 hours |
|---------------------------------------------------------------|-----------------|------------------------------------------------------------|
| Breathing frequency:                                          | Yes             | Yes                                                        |
| Spontaneous breaths per minute (RRsp):                        | Yes             | Yes                                                        |
| Peak Airway Pressure:                                         | Yes             | Yes                                                        |
| Mean Airway Pressure:                                         | Yes             | Yes                                                        |
| Pause Airway Pressure:                                        | Yes             | Yes                                                        |
| End Expiratory Pressure:                                      | Yes             | Yes                                                        |
| CPAP Pressure:                                                | Yes             | Yes                                                        |
| End Expiratory Flow:                                          | Yes             | Yes                                                        |
| Inspired Tidal Volume:                                        | Yes             | Yes                                                        |
| Expired Tidal Volume:                                         | Yes             | Yes                                                        |
| Inspired Minute Volume:                                       | Yes             | Yes                                                        |
| Expired Minute Volume:                                        | Yes             | Yes                                                        |
| Dynamic Characteristics:                                      | Yes             | Yes                                                        |
| Ti/Ttot:                                                      | Yes             | No                                                         |
| Work of Breathing patient:                                    | Yes             | Yes                                                        |
| Work of Breathing ventilator:                                 | Yes             | Yes                                                        |
| Shallow Breathing Index (SBI):                                | Yes             | Yes                                                        |
| Total PEEP:                                                   | Yes             | No                                                         |
| Static Compliance:                                            | Yes             | Yes                                                        |
| Inspiratory Resistance:                                       | Yes             | Yes                                                        |
| Expiratory Resistance:                                        | Yes             | Yes                                                        |
| I:E Ratio:                                                    | Yes             | No                                                         |
| Elastance:                                                    | Yes             | Yes                                                        |
| Time Constant:                                                | Yes             | No                                                         |
| Measured O <sub>2</sub> Concentration:                        | Yes             | Yes                                                        |
| CO <sub>2</sub> End tidal concentration (etCO <sub>2</sub> ): | Yes             | Yes                                                        |
| CO <sub>2</sub> Minute elimination ( $\dot{V}\text{CO}_2$ ):  | Yes             | Yes                                                        |
| Tidal CO <sub>2</sub> elimination (VTCO <sub>2</sub> ):       | Yes             | Yes                                                        |
| MV <sub>e</sub> sp / MV <sub>e</sub> :                        | Yes             | No                                                         |
| Spontaneous Exp. Minute Volume (MV <sub>e</sub> sp):          | Yes             | Yes                                                        |
| Leakage fraction in NIV (%):                                  | Yes             | Yes                                                        |
| P0.1 measurement:                                             | Yes             | Yes                                                        |
| Supply pressure (O <sub>2</sub> and air):                     | Yes             | No                                                         |
| Battery remaining time:                                       | Yes             | No                                                         |
| Barometric pressure:                                          | Yes             | No                                                         |

| Log function |                                                                                                         |
|--------------|---------------------------------------------------------------------------------------------------------|
| Event log:   | Alarms.<br>Ventilator settings.<br>Apnea periods.<br>Immediate functions.                               |
| Service log: | Technical alarms.<br>Test results.<br>Preventive maintenance.<br>Service history.<br>Configuration log. |

## TECHNICAL SPECIFICATIONS

### SERVO-i INFANT

| Parameter settings                                      |                                                                               |
|---------------------------------------------------------|-------------------------------------------------------------------------------|
| Parameter:                                              | Setting range:                                                                |
| Inspiratory tidal volume (ml):                          | 2 – 350 ( <i>Optional – together with volume related ventilation modes</i> )  |
| Inspiratory minute volume (l/min):                      | 0.3 – 20 ( <i>Optional – together with volume related ventilation modes</i> ) |
| Apnea, time to alarm (s):                               | 5 – 45                                                                        |
| Automode Trigger timeout (s):                           | 3 – 15                                                                        |
| Pressure level (cm H <sub>2</sub> O):                   | 0 – (80 – PEEP)                                                               |
| PEEP (cm H <sub>2</sub> O):                             | 0 – 50                                                                        |
| PEEP in NIV (cm H <sub>2</sub> O):                      | 2 – 20                                                                        |
| CPAP pressure (cm H <sub>2</sub> O):                    | 2 – 20                                                                        |
| CMV frequency (breaths/min):                            | 4 – 150                                                                       |
| SIMV frequency (breaths/min):                           | 1 – 60                                                                        |
| Breath cycle time, SIMV (s):                            | 0.5 – 15                                                                      |
| P <sub>High</sub> (cm H <sub>2</sub> O):                | (PEEP + 1) – 50                                                               |
| T <sub>High</sub> (s):                                  | 0.2 – 10                                                                      |
| T <sub>PEEP</sub> (s):                                  | 0.2 – 10                                                                      |
| PS above P <sub>High</sub> (cm H <sub>2</sub> O):       | 0 – (80 – P <sub>High</sub> )                                                 |
| PS above PEEP (cm H <sub>2</sub> O):                    | 0 – (80 – PEEP)                                                               |
| PS above PEEP in NIV (cm H <sub>2</sub> O):             | 0 – (32 – PEEP)                                                               |
| Back-up pressure above PEEP (cm H <sub>2</sub> O):      | 5 – (80 – PEEP)                                                               |
| NIV Back-up rate (breaths/min):                         | 4 – 40                                                                        |
| O <sub>2</sub> concentration (%):                       | 21 – 100                                                                      |
| I:E Ratio:                                              | 1:10 – 4:1                                                                    |
| T <sub>Insp</sub> (s):                                  | 0.1 – 5                                                                       |
| NIV Back-up T <sub>Insp</sub> (s):                      | 0.3 – 1                                                                       |
| T <sub>Pause</sub> (s):                                 | 0 – 1.5                                                                       |
| T <sub>Pause</sub> (% of breath cycle time):            | 0 – 30                                                                        |
| Flow trigger sensitivity level (fraction of bias flow): | 0 – 100%                                                                      |
| Press. trigg sensitivity (cm H <sub>2</sub> O):         | –20 – 0                                                                       |
| Insp. rise time (% of breath cycle time):               | 0 – 20                                                                        |
| Insp. rise time (s):                                    | 0 – 0.2                                                                       |
| Insp. cycle off (% of peak flow):                       | 1 – 70                                                                        |
| Insp. cycle off in NIV (% of peak flow):                | 10 – 70                                                                       |
| Nebulizer time (min):                                   | 5 – 30                                                                        |

| Parameter:                        | Setting range:                                                         |
|-----------------------------------|------------------------------------------------------------------------|
| Oxygen breaths:                   | 100% for 1 minute                                                      |
| Start breath:                     | Initiation of 1 breath (In SIMV mode initiation of 1 mandatory breath) |
| Pause hold:                       | Insp. or exp (0 – 30 seconds)                                          |
| Alarm silence/reset:              | 2 minute silence and reset of latched alarms                           |
| Compliance compensation:          | On/Off                                                                 |
| Automode (optional):              | Automode On/Off                                                        |
| Servo Ultra Nebulizer (optional): | Nebulizer On/Off                                                       |

| Suction Support          |                  |
|--------------------------|------------------|
| Pre oxygenation time:    | Max. 2 min       |
| Post oxygenation time:   | Max. 1 min       |
| Suction phase time:      | No maximum level |
| Adjustable oxygen level: | 21 – 100 %       |

| Saving of data                                      |                                                                                             |
|-----------------------------------------------------|---------------------------------------------------------------------------------------------|
| Recording of current waveform and parameter values: | 20 seconds of data will be recorded (10 seconds before activated key and 10 seconds after). |

| Communication/Interface        |                                                                                            |
|--------------------------------|--------------------------------------------------------------------------------------------|
| Serial port:                   | RS-232C - isolated. For data communication via the Communication Interface Emulator (CIE). |
| Network connection (optional): | MIB (Medical Information Bus) monitor connection                                           |
| Data transfer:                 | Via Ventilation Record Card                                                                |
| Screen picture transfer:       | Via Ventilation Record Card                                                                |

## TECHNICAL SPECIFICATIONS

### SERVO-i INFANT

#### Non Invasive Ventilation (optional)

|                                        |                                                                                                                                                                                                  |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ventilation modes:                     | Non Invasive Ventilation (NIV) Pressure Support.<br>Non Invasive Ventilation (NIV) Pressure Control.<br>Nasal CPAP (The CPAP pressure is kept constant by providing an automatic variable flow). |
| Max. leakage compensation level:       |                                                                                                                                                                                                  |
| – NIV:                                 | 15 l/min                                                                                                                                                                                         |
| – Nasal CPAP:                          | 12 l/min                                                                                                                                                                                         |
| Leakage overrange detection:           | Automatic                                                                                                                                                                                        |
| Disconnect detection:                  | Automatic                                                                                                                                                                                        |
| Connect detection:                     | Manual, or automatic via bias flow                                                                                                                                                               |
| Backup rate (in NIV Pressure Support): | Manually adjustable breathing rate.<br>The breathing rate is controlled by the ventilator in the event of apnea.                                                                                 |

#### Open Lung Tool (OLT) (optional)

|                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Three simultaneous graphical trends, presented breath-by-breath: | <ol style="list-style-type: none"> <li>1. EIP and PEEP (End Inspiratory Pressure and Positive End Expiratory pressure).</li> <li>2. <math>VT_i</math> and <math>VT_e</math> (Inspiratory and Expiratory Tidal volume).</li> <li>3. <math>C_{dyn\ i}</math> and <math>VT_{CO_2}^*</math> (Dynamic inspiratory Compliance [= <math>VT_i / EIP - PEEP</math>] and Tidal <math>CO_2</math> elimination*).</li> </ol> |
|                                                                  | * Requires SERVO-i $CO_2$ Analyzer option connected.                                                                                                                                                                                                                                                                                                                                                             |
| Values stored breath by breath:                                  | Up to 21.600 breaths can be stored.                                                                                                                                                                                                                                                                                                                                                                              |
| Cursor function:                                                 | An activated cursor can be moved with the main rotary dial or via the touch screen. When moving it along the graph, the numeric parameter values valid for that actual moment will be shown at the right hand side of the graphs.                                                                                                                                                                                |
| Zoom function:                                                   | Time resolution of the x-axis can be selected in five different steps.                                                                                                                                                                                                                                                                                                                                           |
| Time marking:                                                    | Hours and minutes (when values are measured).                                                                                                                                                                                                                                                                                                                                                                    |

#### Alarm output connector (optional)

|            |                                   |
|------------|-----------------------------------|
| Connector: | 4-pole Modular connector          |
| Ratings:   | Max 40 V DC, Max 500 mA, Max 20 W |

#### Service

|                      |                                                              |
|----------------------|--------------------------------------------------------------|
| Regular maintenance: | Once every 12 months or at least after 5000 operating hours. |
|----------------------|--------------------------------------------------------------|

#### Note

For inaccuracies and more detailed technical specifications please refer to the User's manual.

## TECHNICAL SPECIFICATIONS

### SERVO-i INFANT

#### ACCESSORIES

##### Servo Ultra Nebulizer, SERVO-i – patient unit (optional)

|                                                     |                                                                                                                                                                               |
|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Weight:                                             | Approx. 125 g                                                                                                                                                                 |
| Dimensions:                                         | H 105 mm x L 108 mm x W 60 mm                                                                                                                                                 |
| Nebulizer T-piece connections:                      | Inlet/outlet: 22/15 mm outer/inner diameter and 22 mm inner diameter, ISO standard.<br>Pediatric patient tubes: Adapters 22/10 mm outer diameter and 15/10 mm outer diameter. |
| Internal volume:                                    | 60 ml                                                                                                                                                                         |
| Ultrasonic generator frequency:                     | 2.4 MHz                                                                                                                                                                       |
| Particle size (water):                              | Mass Median Diameter (MMD) = approximately 4.0 µm, measured distally in endotracheal tube 8 mm inner diameter.                                                                |
| Output from nebulizer (water) – minimum water flux: | Min. 0.1 ml water/min at 0.1 l gas flow/s.<br>Min. 0.3 ml water/min at 0.5 l gas flow/s.                                                                                      |
| Buffer liquid:                                      | Sterile water                                                                                                                                                                 |
| Max. medication temperature:                        | 55° C (131° F)                                                                                                                                                                |
| Volume, medication cup:                             | Max. 10 ml                                                                                                                                                                    |
| Noise level:                                        | Max. 50 dBA, measured at 0.3 m distance.                                                                                                                                      |

##### Servo Ultra Nebulizer, SERVO-i – Connection cable (optional)

|         |       |
|---------|-------|
| Length: | 2.0 m |
|---------|-------|

##### Aeroneb® Pro Nebulizer System (optional)

See separate data sheet.

##### Y sensor measuring (optional)

|                         |                                  |
|-------------------------|----------------------------------|
| Size:                   |                                  |
| – Y Sensor Module:      | 154 x 90 x 43 mm                 |
| – Y sensor infant:      | Length 51 mm                     |
| Weight:                 |                                  |
| – Y Sensor Module:      | 0.4 kg                           |
| – Y sensor infant:      | 7.5 g                            |
| Sensor material:        | Makrolon polycarbonate.          |
| Tubing:                 | 2.0 m. Medical grade PVC.        |
| Power source – Y Sensor | Powered from the SERVO-i.        |
| Module supply voltage:  | <5 W at 12 V (normal operation). |

##### Y sensor measuring – Performance

|                            |                                                                         |
|----------------------------|-------------------------------------------------------------------------|
| Measuring method:          | Fixed orifice, differential pressure.                                   |
| Parameters:                | Airway pressure.<br>Airway flow.<br>Inspiratory and expiratory volumes. |
| Measuring range:           | 0.125 to 40 l/min                                                       |
| Airway adapter dead space: | < 0.45 ml                                                               |

##### SERVO-i CO<sub>2</sub> Analyzer (optional)

|                                    |                                                                           |
|------------------------------------|---------------------------------------------------------------------------|
| Standard compliance:               | EN 864, ISO 9918.                                                         |
| Size:                              |                                                                           |
| – CO <sub>2</sub> Analyzer Module: | 154 x 90 x 43 mm                                                          |
| – Sensor:                          | 32.0 x 42.4 x 21.6 mm                                                     |
| Weight:                            |                                                                           |
| – CO <sub>2</sub> Analyzer Module: | 0.45 kg                                                                   |
| – Sensor:                          | 18 g                                                                      |
| – Airway adapter:                  | 10 g                                                                      |
| Connectors and cables:             |                                                                           |
| – CO <sub>2</sub> Analyzer Module: | 15-pole D-sub female connector.                                           |
| – Sensor:                          | 20-pole, 2.4 m cable.                                                     |
| Power source:                      |                                                                           |
| – CO <sub>2</sub> Analyzer Module  | Powered from the SERVO-i.                                                 |
| supply voltage:                    |                                                                           |
| – Power consumption:               | ≤8 W at 12 V, during warm up.<br>≤6.5 W at 12 V, during normal operation. |
| – Sensor:                          | Powered from the CO <sub>2</sub> Analyzer Module.                         |

## TECHNICAL SPECIFICATIONS

### SERVO-i INFANT

| SERVO-i CO <sub>2</sub> Analyzer – Performance |                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Measuring method:                              | Mainstream, dual-wavelength, non-dispersive infrared.                                                                                                                                                                                                                                                                                                                                                 |
| Parameters:                                    | Capnogram.<br>CO <sub>2</sub> End tidal concentration (etCO <sub>2</sub> ).<br>CO <sub>2</sub> Minute elimination* ( $\dot{V}\text{CO}_2$ ).<br>Tidal CO <sub>2</sub> elimination* (VTCO <sub>2</sub> ).<br><br>* Note: Elimination of CO <sub>2</sub> from the body takes place via expired gas from the lung (Production of CO <sub>2</sub> takes place in cellular compartments and body tissues). |
| Measuring range:                               | 0 to 100 mm Hg CO <sub>2</sub> partial pressure.<br>0 to 13.3 kPa CO <sub>2</sub> partial pressure.<br>0 to 13.2% CO <sub>2</sub> volume (at a barometric pressure of 1013 hPa).                                                                                                                                                                                                                      |
| Step response time:                            | <25 ms (10 to 90% step response).                                                                                                                                                                                                                                                                                                                                                                     |
| Warm-up time:                                  | 30 s to initial CO <sub>2</sub> indication, max. 5 min to full specification.                                                                                                                                                                                                                                                                                                                         |
| Oxygen concentration compensation:             | Automatic. Values supplied from the SERVO-i Ventilator System.                                                                                                                                                                                                                                                                                                                                        |
| Barometric pressure compensation:              | Automatic. Values supplied from the SERVO-i Ventilator System.                                                                                                                                                                                                                                                                                                                                        |
| Digitizing rate:                               | 87 Hz                                                                                                                                                                                                                                                                                                                                                                                                 |
| Airway adapter dead space:                     | <0.5 ml                                                                                                                                                                                                                                                                                                                                                                                               |

| SERVO-i Mobile Cart (optional) |                                                                    |
|--------------------------------|--------------------------------------------------------------------|
| Weight:                        | 20 kg                                                              |
| Dimensions:                    | H 1015 mm x L 640 mm x W 560 mm<br>(see dimensional drawing below) |

| SERVO-i Drawer kit (optional) |                                |
|-------------------------------|--------------------------------|
| Weight:                       | 4.5 kg                         |
| Dimensions:                   | H 240 mm x L 210 mm x W 300 mm |

| SERVO-i Holder (optional) |                                                                   |
|---------------------------|-------------------------------------------------------------------|
| Weight:                   | 3.5 kg                                                            |
| Dimensions:               | H 352 mm x L 247 mm x W 159 mm<br>(see dimensional drawing below) |

| SERVO-i Shelf Base (optional) |                                                                  |
|-------------------------------|------------------------------------------------------------------|
| Weight:                       | 1.2 kg                                                           |
| Dimensions:                   | H 29 mm x L 205 mm x W 159 mm<br>(see dimensional drawing below) |

| Gas cylinder restrainer (optional) |                     |
|------------------------------------|---------------------|
| Max load:                          | 2 x 5-liter bottles |

| SERVO-i IV Pole (optional) |      |
|----------------------------|------|
| Max load (total):          | 6 kg |

| Gas trolley (optional) |                                                                        |
|------------------------|------------------------------------------------------------------------|
| Max load:              | 2x10 kg bottles                                                        |
| Docking:               | Dockable to SERVO-i Mobile Cart.<br>Dockable to a separate wall clamp. |

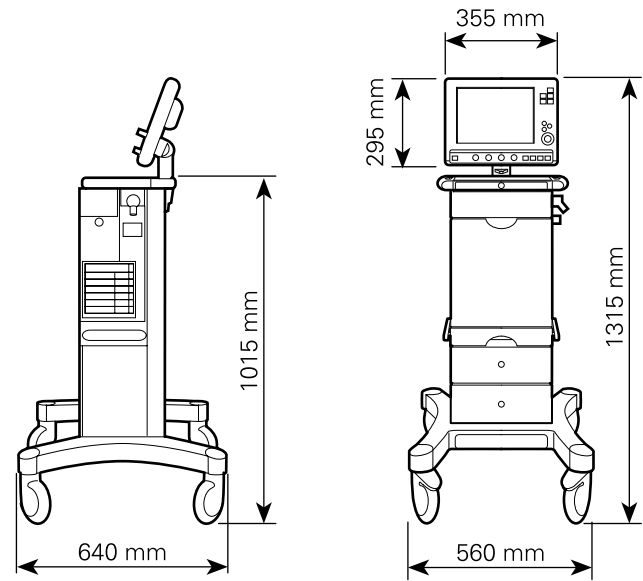
| Compressor Mini (optional) |  |
|----------------------------|--|
| See separate data sheet.   |  |

# TECHNICAL SPECIFICATIONS

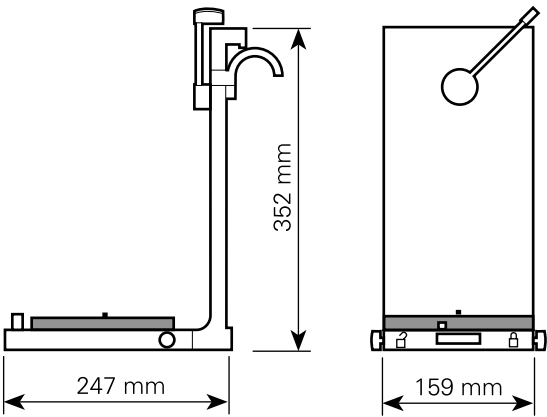
## SERVO-i INFANT

### DIMENSIONAL DRAWINGS

SERVO-i on Mobile Cart

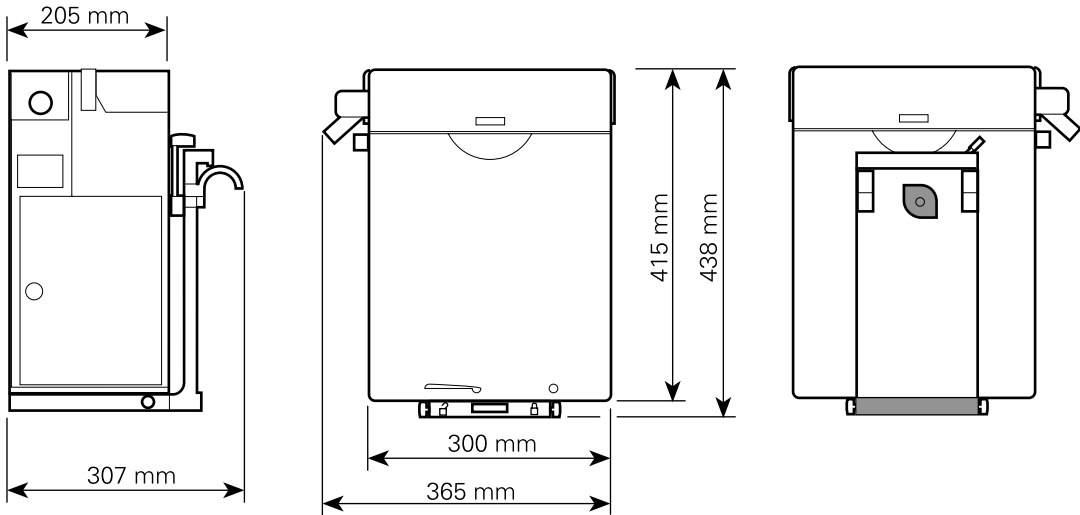


SERVO-i Holder

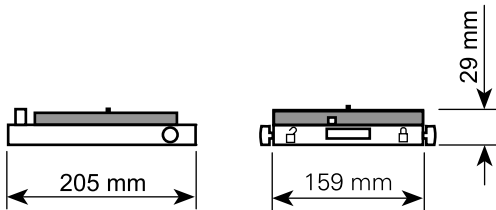


TECHNICAL SPECIFICATIONS  
**SERVO-i INFANT**

SERVO-i (patient unit) on SERVO-i Holder



SERVO-i Shelf Base



## ORDERING INFORMATION

### SERVO-i

**SERVO-i, Ventilator and accessories:** See separate information: “SERVO-i, System Version 3.1 — System Flow Chart” (Order no: 66 70 102).



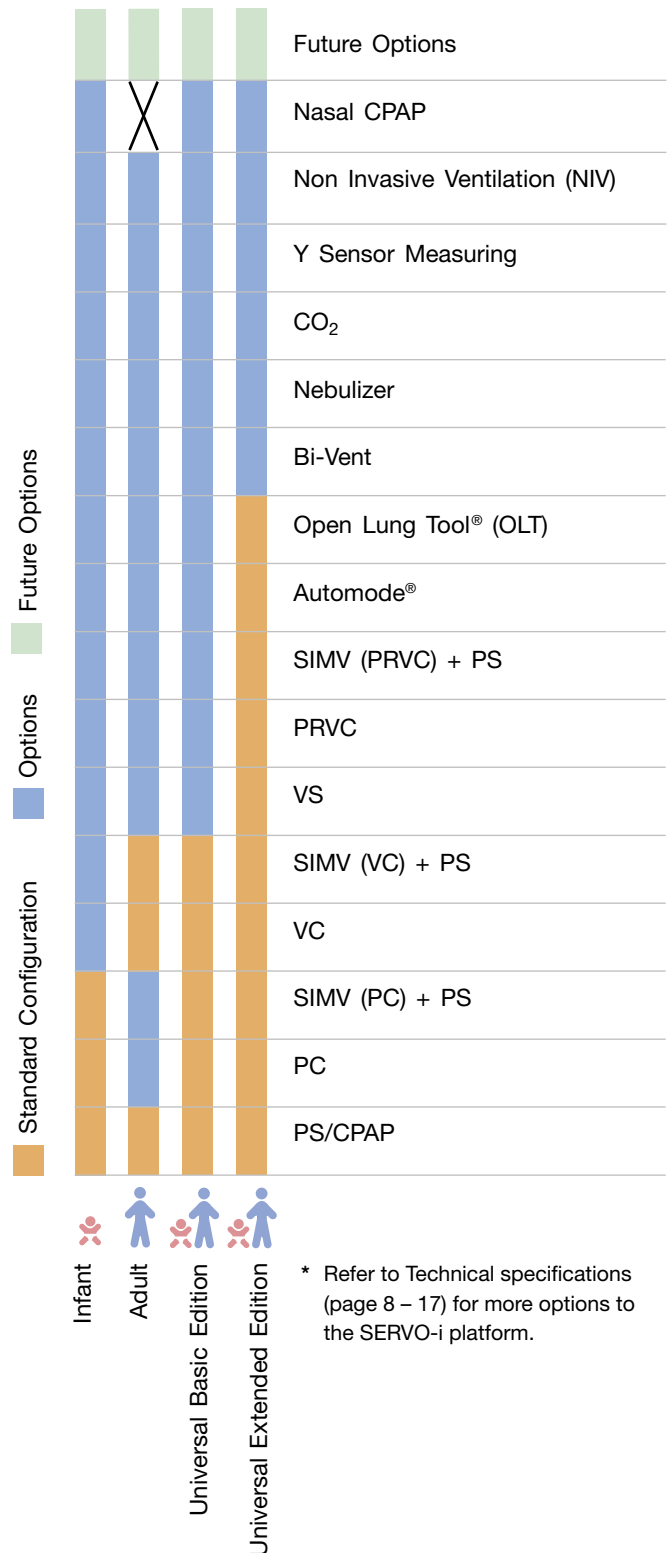
## THE SERVO-i VENTILATOR FAMILY

The **SERVO-i Ventilator family** consists of four configurations:

- SERVO-i Infant
- SERVO-i Adult
- SERVO-i Universal Basic Edition
- SERVO-i Universal Extended Edition

The SERVO-i Ventilator family addresses the very different requirements of neonatal, pediatric and adult needs from a single ventilation platform. All four configurations are the same ventilator, equipped with different functions. They can be customized with different options and upgraded with future options. (SERVO-i Adult and SERVO-i Infant can also be upgraded to SERVO-i Universal.) This means that the same ventilator can be used all over the hospital, facilitating training, operation and maintenance, increasing efficiency and flexibility.

**SERVO-i Ventilatory Configurations\***



# MAQUET

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**For local contact:**

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